

***E. coli* and Total Coliform Sampling of the San Juan River and Selected Inflows from Blanco to McGee Park, September 20-21, 2004**

Methods

Abe Franklin, Scott Clow, and Tom Rice floated down the San Juan River from the Highway 64 bridge at Blanco to McGee Park on September 20 and 21, 2004. Along the way, they collected forty-three samples for bacteria analysis from the river and from selected tributaries, irrigation return flows, and point sources. Twenty-six samples were collected from the San Juan River, eight samples were collected from tributary canyons, four were collected from inflows of relatively clear water most likely associated with off-channel wetlands, irrigation return flow, or urban runoff, and five were collected from pipes discharging to the river. Most samples from the San Juan River were collected with the intent of determining the effect on bacteria levels that a tributary or other inflow may have had on the San Juan River. Accordingly, an effort was made to sample the San Juan River at least one hundred meters downstream of the inflow, to permit mixing. In general, the shallow San Juan River channel appeared conducive to rapid mixing. Although organic debris of various sizes was usually visible from the raft, an effort was made to collect only river water and suspended, sub-visible solids, while avoiding any visible particles. Along with each sample a GPS position accurate to approximately five meters was recorded. Samples were kept on ice for less than six hours before they were processed using the IDEXX bacteria enumeration system. The system uses a most probable number method to estimate numbers of total coliform bacteria and *E. coli* per 100 mL of sample. The maximum estimate the system can provide (without dilution, when all but one well is positive) is 2419.6 colony forming units per 100 mL. When all wells are positive, the resulting estimate is greater than 2419.6 cfu/100mL, or too numerous to count.

A regional storm system produced rain showers over probably the entire San Juan Basin on September 19, and again during the night of September 20 and 21. It did not rain during sample collection, but several normally dry tributary arroyos were running, and several additional inflows may have been composed wholly or partly of runoff from these storms.

Results

Table I lists the samples collected and the results. Figures 1 – 7 indicate the sample locations relative to other features. Sample site descriptions in Table I are based in part on field observations, map interpretation, and interpretation of orthophotography prepared by the U.S. Bureau of Reclamation from aerial photography collected on July 12 2001.

Table 1: Sample descriptions and results

Sample Number	Date/Time	Sample Site Description	Total Coliform (cfu/100mL)	E. coli (cfu/100mL)
1	9/20/04 10:30	San Juan River at Blanco Bridge	>2419.6	365.4
2	9/20/04 10:45	San Juan River above Largo Canyon	>2419.6	517.2
3	9/20/04 10:55	Largo Canyon at mouth	>2419.6	>2419.6
4	9/20/04 11:00	San Juan River below Largo Canyon	>2419.6	1119.9
5	9/20/04 11:04	San Juan River downstream of two relatively clear inflows from right bank	>2419.6	2419.6

Sample Number	Date/Time	Sample Site Description	Total Coliform (cfu/100mL)	E. coli (cfu/100mL)
6	9/20/04 11:26	San Juan River downstream of seepage from bluff on right bank	>2419.6	1553.1
7	9/20/04 11:29	Clear inflow to San Juan from right bank	sample	misplaced
8	9/20/04 11:40	San Juan River downstream of Muñoz Canyon	>2419.6	1732.9
9	9/20/04 11:58	San Juan River adjacent to pasture (probably) off of left bank	>2419.6	1732.9
10	9/20/04 12:05	Armenta Canyon at mouth	>2419.6	770.1
11	9/20/04 12:23	San Juan River secondary channel downstream of Wright Canyon	>2419.6	>2419.6
12	9/20/04 12:27	San Juan River downstream of Armenta and Wright Canyons	>2419.6	1413.6
13	9/20/04 12:30	Slane Canyon at mouth	>2419.6	866.4
14	9/20/04 12:55	San Juan River downstream of relatively clear inflow on right bank	>2419.6	1553.1
15	9/20/04 13:13	San Juan River downstream of inflow on right bank	>2419.6	2419.6
16	9/20/04 13:33	San Juan River downstream of Sullivan Canyon and relatively clear inflows with nutrient indicators on right bank	>2419.6	1732.9
17	9/20/04 13:40	Hare Canyon at mouth	>2419.6	387.3
18	9/20/04 13:47	San Juan River downstream of Hare Canyon	>2419.6	1732.9
19	9/20/04 13:50	Pair of pipes discharging from right bank to San Juan River	>2419.6	1553.1
20	9/20/04 14:01	San Juan River upstream of Giant Refinery	>2419.6	1986.3
21	9/20/04 14:10	Bloomfield Canyon at mouth	>2419.6	1413.6
22	9/20/04 14:20	San Juan River at boat ramp opposite refinery	>2419.6	1986.3
23	9/21/04 9:50	San Juan River at boat ramp opposite refinery	>2419.6	360.9
24	9/21/04 9:57	Inflow from wetland to right bank of San Juan River	bottle	cracked
25	9/21/04 10:00	San Juan River at Bloomfield Bridge	>2419.6	365.4
26	9/21/04 9:53	Pipe discharging from right bank to San Juan River	>2419.6	222.4
27	9/21/04 10:12	Bloomfield WWTP Discharge	>2419.6	10.9
28	9/21/04 10:15	Clear inflow from right bank	>2419.6	686.7
29	9/21/04 10:20	San Juan River downstream of several inflows on right bank	>2419.6	325.5
30	9/21/04 10:40	Green Canyon at mouth	>2419.6	1986.3
31	9/21/04 10:50	San Juan River downstream of Green Canyon and another, smaller clear inflow	>2419.6	328.2
32	9/21/04 11:10	San Juan River downstream of Kutz Canyon	>2419.6	435.2
33	9/21/04 11:32	San Juan River downstream of at least two clear inflows from right bank	>2419.6	579.4
34	9/21/04 11:35	Horn Canyon at mouth	>2419.6	816.4
35	9/21/04 11:40	San Juan River at Jeff Blagg property	>2419.6	461.1
36	9/21/04 12:05	Corrugated metal pipe inflow from left bank downstream of horse pasture	>2419.6	>2419.6
37	9/21/04 12:14	San Juan River downstream of pipe discharge	>2419.6	435.2
38	9/21/04 12:20	Unnamed tributary entering San Juan River on Right Bank	>2419.6	>2419.6

Sample Number	Date/Time	Sample Site Description	Total Coliform (cfu/100mL)	E. coli (cfu/100mL)
39	9/21/04 12:30	Clear and warm inflow to San Juan River from left bank	>2419.6	387.3
40	9/21/04 12:53	San Juan River at Lee Acres bridge	>2419.6	365.4
41	9/21/04 13:15	San Juan River at McGee Park	>2419.6	387.3
42	9/21/04 13:15	San Juan River at McGee Park (no reagent control)	0	0
43	9/21/04 13:15	Pipe discharging from right bank of San Juan River at McGee Park	167.0	1.0
44	9/21/04 13:15	Pipe discharging from right bank of San Juan River at McGee Park (duplicate)	28.5	4.1
45	9/21/04 14:10	Farmington tap water (no coliform bacteria control)	0	0

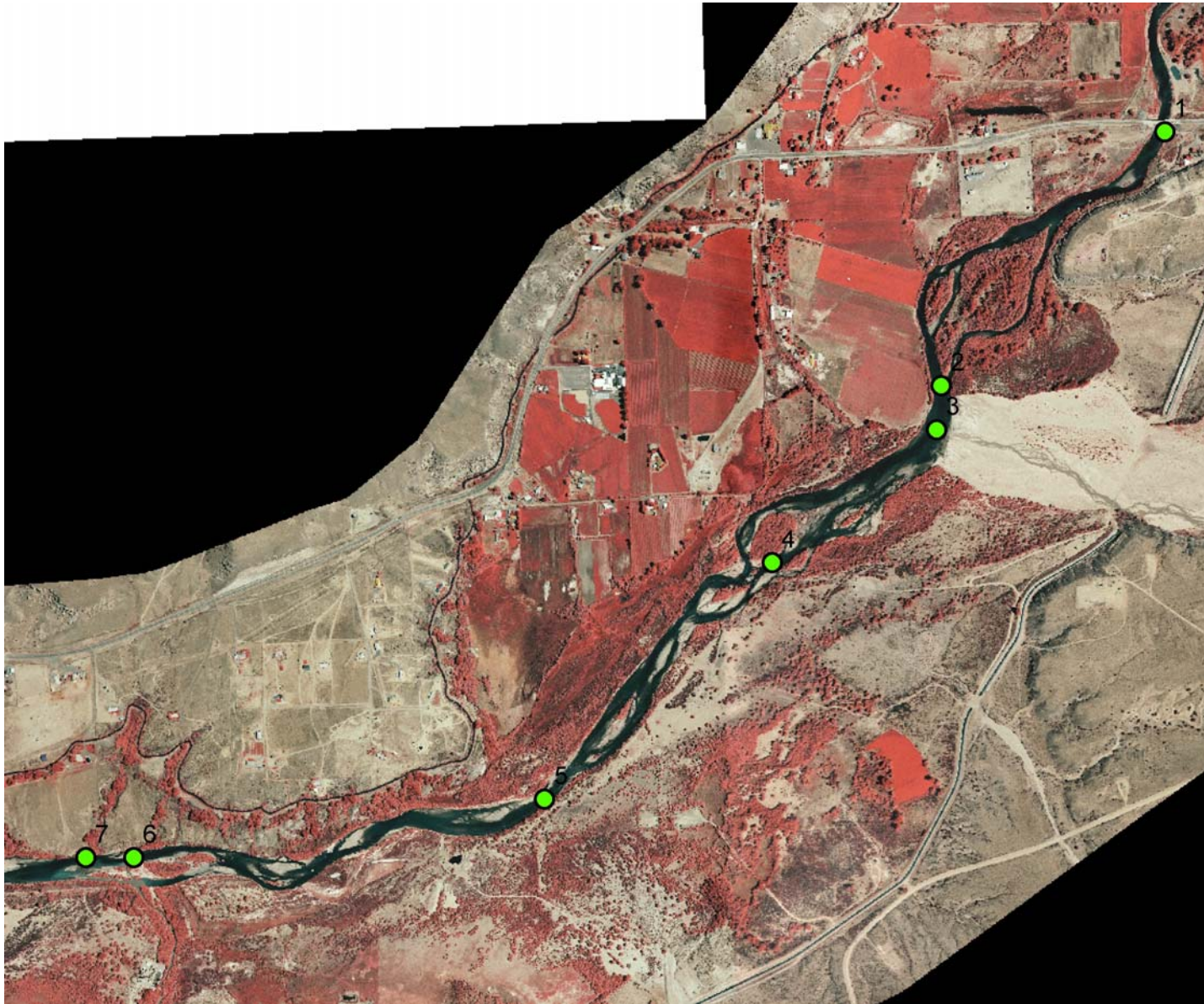


Figure 1: San Juan River Blanco reach *E. coli* sampling sites 09/20/2004. July 2001 orthophoto background.

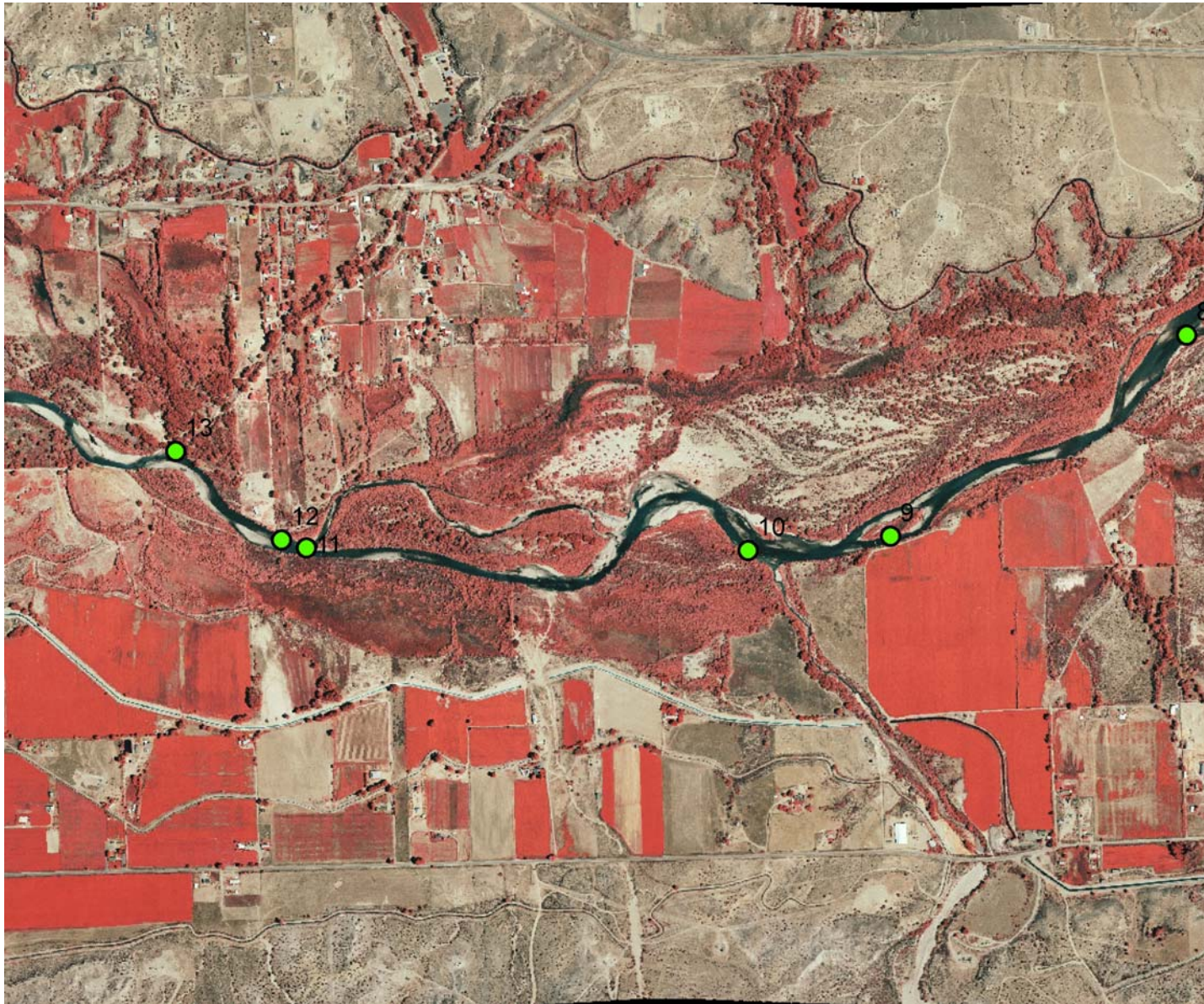


Figure 2: San Juan River Hammond reach *E. coli* sampling sites 09/20/2004. July 2001 orthophoto background.



Figure 3: San Juan River West Hammond reach *E. coli* sampling sites 09/20/2004. July 2001 orthophoto background.

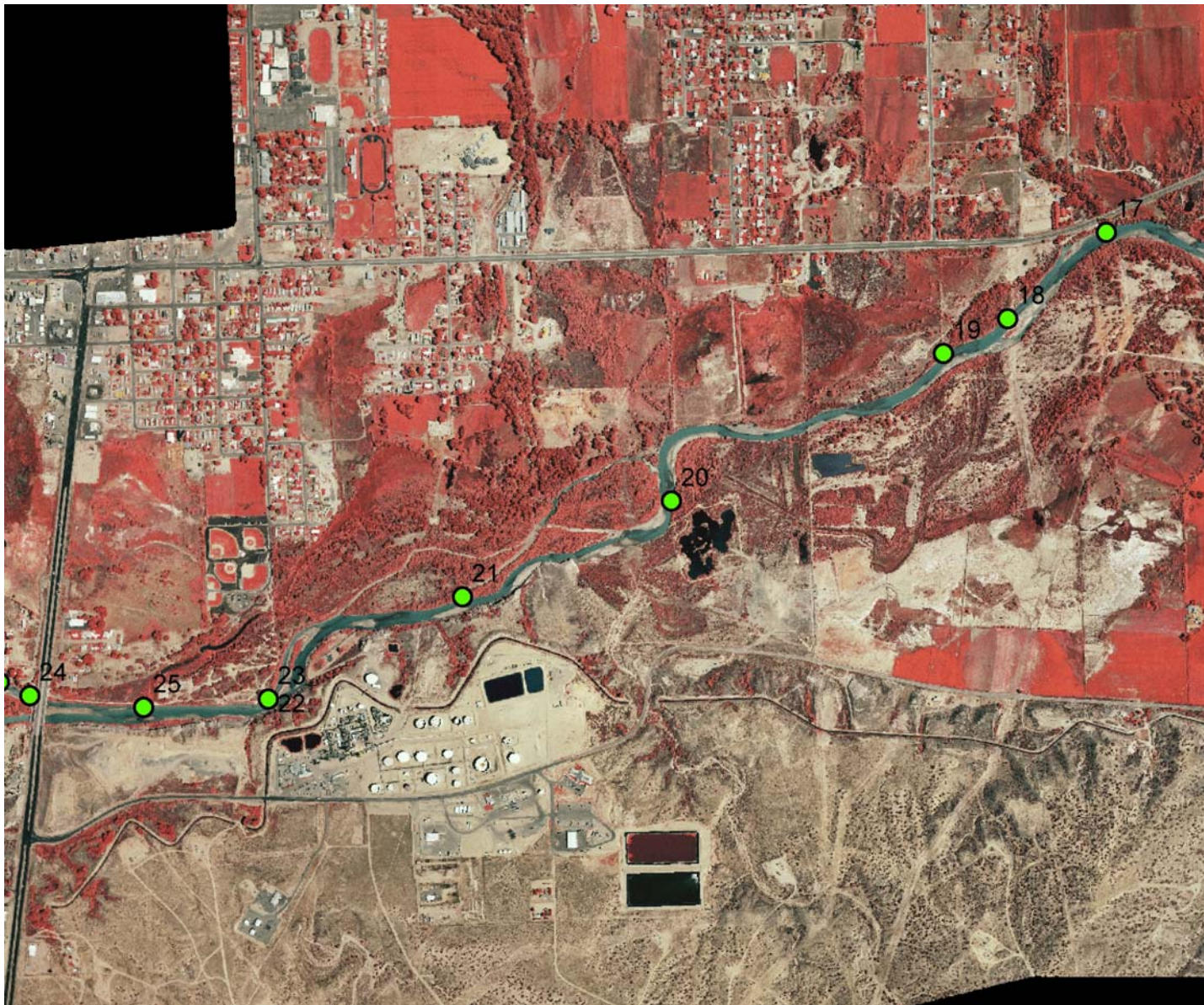


Figure 4: San Juan River East Bloomfield reach *E. coli* sampling sites 09/21/2004. July 2001 orthophoto background.



Figure 5: San Juan River West Bloomfield reach *E. coli* sampling sites 09/21/2004. July 2001 orthophoto background.



Figure 6: San Juan River East Lee Acres reach *E. coli* sampling sites 09/21/2004. July 2001 orthophoto background.



Figure 7: San Juan River West Lee Acres reach *E. coli* sampling sites 09/21/2004. July 2001 orthophoto background.

Discussion

From the results, the following general interpretations were made:

1. Total coliforms, with few exceptions, were too numerous to count. *E. coli* was generally countable, and provides the most useful data for comparisons.
2. Of all inflows to the San Juan River sampled, few appear to have had a noticeable effect on *E. coli* levels in the San Juan River on the dates sampled. Largo Canyon appears to have had a noticeable effect (comparing samples 2 and 4), and two clear inflows from off-channel wetlands near the community of Blanco may have had an effect (compare samples 4 and 5). Alternatively, sample 5 may have had a higher *E. coli* result than sample 4 because of additional mixing of suspended solids from Largo Canyon with San Juan River water. Kutz Canyon may have had an effect, as the *E. coli* results downstream of Kutz Canyon were generally greater than the results upstream on September 21.
3. Of the tributary canyons sampled, five (Largo, Wright, Green, Horn, and an unnamed canyon flowing southward upstream of Lee Acres, sample numbers 3, 11, 30, 34, and 38) had *E. coli* levels greater than the San Juan River at nearby sampling sites, but only Largo Canyon seems to have had an appreciable effect on *E. coli* levels in the San Juan River. The Wright Canyon sample (sample 11) may have been composed partly of water from the San Juan River, and had an *E. coli* result greater than 2419.6 cfu/100mL even after any mixing that occurred. Armenta, Slane, Hare, and Bloomfield Canyons (sample numbers 10, 13, 17, and 21) had *E. coli* levels lower than the San Juan upstream of these canyons. Kutz Canyon was not sampled directly, but may have increased *E. coli* levels in the San Juan River.
4. Another category of inflows are those which were relatively clear, and thought to be from wetlands, irrigation return flow, urban runoff, seepage from leach fields, or some combination of these. Data are available for only two of these (samples 28 and 39). One such flow, entering the San Juan River from the right bank near the downstream end of Bloomfield, had a result for *E. coli* somewhat greater than that of the San Juan River nearby. This flow is thought to drain a wetland, and may have been augmented by urban runoff. The other such inflow, entering the San Juan from the left bank near Lee Acres, had an *E. coli* result similar to that of the San Juan. The map and orthophoto together suggest that a natural drainage may have been re-routed to drain storm runoff from a small, new, and relatively high-density residential area. There may also be irrigation return flow contributing to this inflow.
5. A third category of inflows are those entering the river via pipes, and which are tentatively being thought of as point sources. Some of the pipes may be relatively short, and may simply convey irrigation return flow a short distance from a nearby field to the river. In most cases, it was not possible to determine the source of the flow. All of these but one (samples 19, 26, 27, and 43) had a lower *E. coli* measurement than the nearby San Juan River. One (sample 36) had an *E. coli* value too numerous to count, but because of its low flow relative to the San Juan River, did not appear to effect the levels

observed in the San Juan River downstream. This pipe was a corrugated metal pipe approximately one foot in diameter, and as such probably was not very long. Interpretation of the orthophoto indicates the pipe may drain nearby irrigated fields or a medium density residential area, and its flow may have been augmented by storm runoff.

Some additional observations may be relevant to interpreting these data. Organic debris composed of sticks, juniper needles, and possibly animal manure were observed floating in the San Juan River on both days of sampling. What appeared to be intact cow patties, and small pellets that may have been rabbit droppings were seen floating in the river but not inspected closely enough to confirm that. Some component of the floating debris appeared to possibly be particles of disintegrated cow patties. At one location, cow patties and horse or mule manure were identified with certainty among recently deposited debris on the bank.

The presence of a variety of visible debris in the water column clearly indicates that recent runoff events were still having an effect on water quality of the San Juan River on the sampling dates. The relative contributions by various sampled and unsampled tributaries may not be well indicated by the data. That *E. coli* levels in the San Juan River on September 21 were only about one third of the levels observed on September 20 suggests that most of the *E. coli* loading was carried by runoff from the regional storm pattern (rather than continuously flowing sources), and that most of the fecal matter from livestock and wildlife had been washed through the system by the second day of sampling. Several of the smaller watersheds may have already been washed relatively clean by the first day of sampling, while runoff from the more distant parts of the huge Largo Canyon watershed may have only just been reaching the San Juan on the first day of sampling. The bacterial load from the smaller watersheds may have been more significant nearer the beginning of the rains.

Several factors probably interact to influence the levels of bacteria in the San Juan River, and variability in these may have very different results at different times. For example, in a watershed where livestock and wildlife feces may be carried by runoff to the San Juan River, the period of time passed since the last runoff event may increase the loading from that watershed. The characteristics of a precipitation event (duration, intensity, and spatial extent), as well as soils and management practices in the watershed, may influence infiltration and runoff rates and amounts. Any loading associated with runoff events is in addition to more constant bacteria loading that may be occurring.

Even after Largo Canyon and the other canyons empty their loads of fine sediment, organic matter, and presumably bacteria into the San Juan River, it is apparent that some time passes before the loads are washed downstream in the San Juan. The discharged material is generally temporarily suspended and then redeposited, and moves much more slowly than water in the San Juan River. The resulting concentrations of bacteria in the San Juan River may therefore depend on viability of the organisms in this environment (the rate at which they die out) as much as on the factors noted above.

Results Relative to Proposed Water Quality Standards

The proposed single sample water quality criterion for *E. coli* in ephemeral waters and unclassified perennial waters is 2507 cfu/100 mL. The proposed criterion was not exceeded for most of these waters. Where the *E. coli* result was greater than 2419.6 cfu/100mL (Largo

Canyon, probably Wright Canyon, and an unnamed tributary from the north near Lee Acres - samples 3, 11, and 38), dilution of samples would be required to make these determinations. The proposed single sample criterion for the San Juan River is 410 cfu/100mL (235 cfu/100mL above Largo Canyon). On the first day of sampling, every sample from the San Juan River exceeded the proposed criteria. On the second day of sampling, the four samples collected from the San Juan between Kutz Canyon and the Giant Refinery in Bloomfield were slightly less than the proposed single sample criterion, while the next four San Juan samples downstream of Kutz Canyon slightly exceeded the proposed criterion. The final two samples collected from the San Juan on the second day (at Lee Acres bridge and McGee Park) did not exceed the proposed criterion.

Future Work

This sampling effort has demonstrated that constant loading seems to contribute proportionately fewer bacteria than runoff during and shortly after storm events. Without similar data from a drier period, it is difficult to conclude that significant loading does not result in poor water quality at other times. A review of existing data, though not conclusive, indicates that bacteria levels are generally (but not always) low in the San Juan and Animas Rivers between mid March and mid August, when boaters and swimmers are most at risk of exposure to pathogens. Given the relative ease with which this survey was conducted, similar surveys should be conducted in the Animas and San Juan Rivers during the period of relatively common recreational use, to provide a more useful indication of the health threat associated with swimming and boating in these rivers, and to better assess sources of bacteria other than surface runoff associated with storm events.